CLAIMS

What is claimed is:

1. An optical modulator device comprising:

a substrate formed from a semiconductor material;

an optically active layer formed on an upper surface of the substrate, the optically active layer including a layer of SiGe having a quantum well to provide electro-absorption of light in the optically active layer;

a layer of semiconductor material formed on an upper surface of the optically active layer; and

an electrical contact formed on an upper surface of the layer of semiconductor material to provide an electric field to alter the electro-absorption of light in the optically active layer.

2. The device of claim 1, wherein the layer of SiGe comprises a layer of SiGe nanocrystals.

3. The device of claim 1, wherein the layer of SiGe is a strained layer of SiGe having a dopant to provide electrons in the strained layer of SiGe.

4. The device of claim 3, wherein the dopant is at least one of arsenic, phosphorus, and antimony.

5. The device of claim 3, wherein the strained layer of SiGe is between 20 and 70 percent Germanium.

6. The device of claim 5, wherein the strained layer of SiGe is 27 percent Germanium.

7. The device of claim 3, wherein the substrate is formed from silicon.

8. The device of claim 3, further comprising:

a second layer of semiconductor material formed on an upper surface of the substrate; and

wherein the optically active layer is formed on an upper surface of the second layer of semiconductor material.

9. The device of claim 8, wherein the second layer of semiconductor material is formed from silicon.

10. The device of claim 3, wherein the optically active layer further comprises:

a layer of semiconductor material formed on an upper surface of the first strained layer of SiGe; and

a second strained layer of SiGe formed on an upper surface of the semiconductor layer to provide a second quantum well, wherein the second strained layer of SiGe is doped with arsenic.

11. The device of claim 10, wherein a ratio of silicon to germanium in the first strained layer is different than a ratio of silicon to germanium in the second strained layer.

12. The device of claim 1, wherein the optical modulator is an optical waveguide modulator.

13. The device of claim 12, further comprising an optical cavity in optical communication with the optically active layer.

14. The device of claim 1, wherein the layer of SiGe has a thickness between five and thirty nanometers.

15. The device of claim 1, wherein the substrate is formed from germanium.

16. An optical modulator device comprising:

a substrate formed from a semiconductor material;

a first reflective layer formed on an upper surface of the substrate to provide a first reflective surface;

a first cladding layer formed on an upper surface of the first reflective layer;

an optically active layer formed on an upper surface of the first cladding layer, the optically active layer including a strained layer of SiGe having a quantum well to provide electro-absorption of light in the optically active layer;

a second cladding layer of dielectric material formed on an upper surface of the optically active layer; and

a second reflective layer formed on an upper surface of the second cladding layer to provide a second reflective surface.

17. The optical modulator device of claim 16, wherein the strained layer of SiGe is doped with arsenic.

18. The optical modulator device of claim 17, wherein a concentration of arsenic in the strained layer of SiGe is greater than 1×10^{18} atoms per cubic centimeter.

19. The optical modulator device of claim 18, wherein a concentration of arsenic in the strained layer of SiGe is between 1×10^{18} atoms per cubic centimeter and 6×10^{20} atoms per cubic centimeter.

20. The optical modulator device of claim 16, wherein the strained layer of SiGe is between 20 and 70 percent Germanium.

21. The optical modulator device of claim 16, wherein the substrate is formed from silicon.

22. A method comprising:

receiving an optical signal at an optical modulator device having an optically active layer, the optically active layer including a strained layer of SiGe having a quantum well to provide electro-absorption for the received optical signal;

applying an electric field to the optical modulator device to alter the electro-absorption of the optically active layer;

modulating the received optical signal responsive to the altered electro-absorption of the optically active layer; and

providing the modulated optical signal to an integrated circuit chip.

23. The method of claim 22, wherein the strained layer of SiGe is doped with arsenic.

24. The method of claim 23, wherein the strained layer of SiGe is between 20 and 70 percent Germanium.

25. A system comprising:

a first integrated circuit (IC) chip formed from a silicon substrate, the first IC chip including an optical modulator with an optically active layer, the optically active layer including a strained layer of SiGe having a quantum well to provide electro-absorption of light;

an optical pathway optically coupled at a first optical pathway end to the optical modulator; and

a second IC chip having a photodetector optically coupled to a second optical pathway end.

26. The system of claim 25, wherein the strained layer of SiGe is doped with arsenic.

27. The system of claim 26, wherein a concentration of arsenic in the strained layer of SiGe is greater than 1×10^{18} atoms per cubic centimeter.

28. The system of claim 27, wherein a concentration of arsenic in the strained layer of SiGe is between 1×10^{18} atoms per cubic centimeter and 6×10^{20} atoms per cubic centimeter.

29. The system of claim 26, wherein the strained layer of SiGe is between 20 and 70 percent Germanium.

30. The system of claim 29, wherein the optically active layer further comprises:

a second strained layer of SiGe formed on an upper surface of the first strained layer of SiGe to provide a second quantum well, wherein the second strained layer of SiGe is doped with arsenic.

31. An integrated circuit comprising:

a substrate formed from a semiconductor material;

an optical modulator with an optically active layer formed on the semiconductor substrate, the optically active layer including a strained layer of SiGe having a quantum well to provide electro-absorption of light; and

an optical fiber having a first end in optical communication with the optical modulator.

32. The system of claim 31, wherein the strained layer of SiGe is doped with at least one of arsenic, phosphorus, and antimony.

33. The system of claim 32, further comprising a light-emitting source fabricated on the semiconductor substrate to provide an optical signal to the optical modulator.

34. The system of claim 33, further comprising a photodetector in optical communication with a second end of the optical fiber to receive light.

35. The system of claim 31, wherein the substrate is formed from silicon.

36. The system of claim 35, wherein the strained layer of SiGe is between 20 and 70 percent Germanium.